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Cyclonic Distribution of Precipitation

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CYCLONIC DISTRIBUTION OF PRECIPITATION.

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Plate XVII

Several years ago I devised a method for ascertaining statistically the relation of weather conditions to different parts of a cyclone for a certain locality or limited region of territory. Some results obtained by this method seem worth the while recording.

The method followed was: by marking off eight radii in four concentric circles I plotted twenty-five areas in a figure, which could be used to represent definite separate tracts in a circular storm. The lengths of the radii of the circles had the ratios 1:4:7:10, and could be used to represent the same number of hundreds of miles in a cyclone two thousand miles in diameter. The radii was drawn at angles of 45° and were not extended into the inner circle. There were thus three tracts marked off in each octant outside the smallest circle. With this latter representing the central region of a cyclone and the figure so oriented as to allow the four points of the compass to bisect four alternate octans, it was used to delimit twenty-five fixed areas in a cyclone. The construction of the figure will be readily understood from the accompanying diagram (Fig. 1) where each area is designated by number.

My method was then to take a sufficient number of observations on the weather at the desired locality when this lay in each of the twenty-five corresponding tracts in an actual cyclone.

These were then averaged for each tract separately, and percentages of frequency of certain weather conditions were thus obtained for each area, such as frequency of precipitation, of cloudiness and of wind direction. The station selected for the first study was Davenport, Iowa, and the data used were the observations taken at this station at 8 A. M. The location of the low areas was taken from the daily weather maps, each corresponding day, by using a transparent paper with a diagram drawn to the scale of the map. Days, when no low areas appeared within a thousand miles of Davenport, were left out. Nearly a thousand observations were used, taken from as many maps. These were distributed somewhat unevenly in the twenty-five tracts of the diagram, but it is believed the number in each tract was large enough to secure a fairly representative average.

It will be seen that this is nothing but a simple method of averaging weather conditions for different parts of a cyclone at a particular station. The results can be plotted on the diagram as a chart. I have called such a chart a *composite cyclone*. For the morning hour precipitation was found to be most frequent at Davenport when this station lies in the tract numbered eight, which extends from 100 to 400 miles west of the central "low". It was also found unexpectedly high in tract numbered twenty-two, which lies from seven hundred to one thousand miles south of the "low". In a southeast direction precipitation decreased very rapidly from the center of this composite cyclone.

Cyclonic conditions were averaged in a like manner for some other places, representing four other climatic regions in the United States. It was found expedient to make use of data slightly different from those used in the Davenport cyclone. I combined the 8 A. M. observations taken at Amarillo, Dodge City, Wichita, and Oklahoma during the years

1894-1898, obtaining a chart which presumably is characteristic for the cyclonic conditions on the southwest plains. I also combined into like averages the same observations at Helena, Miles City, Leander and Boise City for 1899; those taken at nine stations in the Upper Mississippi Valley in 1899; and those taken at Detroit and at Buffalo during the years 1900-1903.

The percentages of precipitation in the twenty-four cyclonic tracts for each of the five localities thus averaged are given in the following table, and the same data are plotted in the accompanying figures (Figs. 2-6).

TABLE.

Showing percentages of precipitation in twenty-four different tracts of five composite cyclones in different parts of the United States.

Number of Tract.	Davenport.	Amarillo, Dodge City, Wichita and Oklahoma.	Helena, Miles City, Leander, and Boise City.	Missouri Valley Stations.	Detroit and Buffalo
1	26	3	0	20	44
2	21	14	17	21	40
3	15	20	10	11	40
4	0	—	6	8	40
5	3	5	0	5	26
6	4	3	3	5	15
7	7	9	3	7	15
8	35	5	13	11	26
9	17	21	16	15	33
10	17	21	18	20	25
11	8	19	6	20	18
12	8	13	14	6	17
13	6	2	10	2	18
14	4	2	6	5	5
15	4	8	4	2	0
16	10	6	5	5	34
17	0	21	20	6	25
18	17	18	1	8	9
19	19	6	12	9	8
20	2	6	8	8	9
21	2	6	5	2	6
22	22	6	2	3	—
23	7	7	2	4	0
24	6	7	3	4	1
25	0	6	16	3	0

These tables and charts show clearly: 1. That the area of greatest precipitation is not the same for different stations. They suggest that the cyclonic distribution of precipitation bears a definite relation to climate, and varies with this.

2. That if the area of greatest precipitation is to the southeast of the center of cyclones in the Upper Mississippi Valley (as taken for granted hitherto in general works on American meteorology?) there must be a very marked diurnal shifting of this area concerning which nothing is at yet known; for to make up for the deficiency of precipitation in this part of the composite cyclone of the morning hour there would have to be a corresponding excess during some other part of the day.

3. That, in either case, the variations in the location of this area of greatest precipitation, be they local or diurnal, are quite probably of sufficient magnitude to appreciably affect the accuracy of weather forecasts.

Explanation of Figures.

Plate XVII.

Fig. 1. This figure shows the location of each of the twenty-five tracts as averaged in each cyclonic area. The numbers are those given under the columns "number of tracts" in the preceding tables.

Fig. 2. Distribution of precipitation and wind directions in a composite cyclone, based on the 8 A. M. observations taken at Davenport during the years 1893-1897.

Fig. 3. Distribution of precipitation and wind directions in a composite cyclone, based upon the 8 A. M. observations taken at Amarillo, Dodge City, Wichita and Oklahoma during the years 1894-1898.

Fig. 4. Distribution of precipitation and wind directions in a composite cyclone, based upon the 8 A. M. observations taken at Helena, Miles City, Leander and Boise City in 1899.

Fig. 5. Distribution of precipitation and wind direction in a composite cyclone, based on the 8 A. M. observations taken at all the stations in the Upper Missouri Valley during 1899.

Fig. 6. Distribution of precipitation and wind direction in a composite cyclone, based on the 8 A. M. observations taken at Detroit and Buffalo during the years 1900-1903.

Note: In the figures numbered 2, 3, 4, 5 and 6, the shading represents different percentages of precipitation as follows:

Solid black,	40 per cent, and above.
Crossed parallel lines,	30-39 per cent,
Parallel lines,	20-29 per cent,
Interrupted parallel lines,	10-19 per cent,
No shading, less than	10 per cent,